Remarks

In the following, locations in Applicants' Specification are cited as paragraphs in US2005/0216518 A1, the printed publication of Applicants' application.

Support for the claims as amended in the Specification as filed

Examiner will immediately see that claims 1 and 36, the amended claims, are fully supported by the Specification as filed.

The amendment of claim 36 to overcome the rejection under 35 U.S.C. 112, 2. paragraph

The amendment simply replaces "such" in line 8 of the claim with what it refers to, namely – provided by the database system to users of the system" from line 5.

The rejections of claims 1, 22, and 44 under 35 U.S.C. 101

Claim 1

Claim 1 has been amended to recite hardware components of the claim's database system. As amended the claim is clearly directed to statutory subject matter.

Traversal of the rejection of claims 22 and 44

Examiner rejects these claims because they "claim a bitmap value which is a number". In the Specification, bitmaps and bitmap values are defined as follows:

> A *bitmap* is a sequence of bits which has been mapped to a set of objects. Each bit corresponds to one of the objects in the set. A *bitmap value* is a bitmap in which bits have been set to specify a subset of the set of objects. [0017]

It will be apparent from the foregoing definition that the "bitmap value" to which claims 22 and 24 are addressed does not represent a number. Instead, as set forth in the claim, a "bitmap value" represents a set of objects that are defined in the database system.

As such, the "bitmap value" is a data structure "employed in a database system" and consequently represents statutory subject matter by the standard set forth in MPEP 2106.01(I).

Traversal of the rejections under 35 U.S.C. 102

The following *Traversal* is an adaptation to the present circumstances of one already made in the *Response to a final Office action* filed on 18 December 2008. The *Traversal* will first

discuss prior art bitmap indexes generally, then the relationship between Applicants' claims and the prior art, and will finally show that Koskas discloses nothing beyond the prior art and that Applicants' claims are consequently patentable over the references.

Prior-art bitmap indexes

Applicants' *Background of the invention* points out at [0017] that relational database management systems have long provided bitmap indexes and beginning at [0018], provides a short description of prior-art bitmap indexes as they are implemented in the Oracle 9*i* relational database management system. As shown there, the user interface to these bitmap indexes is SQL DDL statements which permit the user to specify that the relational database system construct a bitmap index on a field of a table and permit the user to specify that an existing bitmap index be dropped. The relational database management system then uses the bitmap index as described at [0014] for indexes generally: it automatically updates the bitmap index in response to changes in the table the index belongs to and automatically uses the bitmap index to speed up queries on the table that involve the field indexed by the bitmap index. An example of using a bitmap index to speed up queries may be found at [0023]. Limitations of prior-art bitmap indexes are described at [0035]. Among these limitations is the fact that the user has no direct access to the primitive operations which the relational database system performs on the bitmap. Thus, as set forth at [0035], there is no operation which permits a user to make a bitmap value that represents the rowids returned by a user-defined query.

Applicants' claims and the prior art

Applicants' disclosure sets forth at [0039] than an object of Applicants' invention is to provide "a database management system in which programmers had access to bitmap values specifying subsets of large sets of values and to primitive operations for the bitmap values ...". Applicants' claim 1 as amended in the present response expressly sets forth such a relational database system:

> **1.** (currently amended) A database management system including a processor and persistent storage, the processor executing code for the database management system and the persistent storage containing database objects that are manipulated by the processor when executing the code for the database management system, the data base management system having the improvement comprising:
>
> database objects in the persistent storage that are bitmap values, a bitmap value having a representation of a bitstring wherein set bits specify a set of the

database objects whose definitions are built into the database management system, and

bitmap operations implemented in the code for the database management system, a bitmap operation having a user-specified operand which is a bitmap value and/or a set of objects.

The language "a bitmap operation having a user-specified operand which is a bitmap value and/or a set of objects" clearly sets forth that the user has access to primitive operations on the bitmap values and thus distinguishes claim 1 from the prior art described in Applicants' *Description of related art*. Language that similarly sets forth user access to primitive operations on the bitmap values is found in Applicants' other independent claims 22, 36, and 44.

The disclosure of Koskas

As set forth at col. 18, line 55 through col. 20, line 19, Koskas discloses a database system in which the data to be stored in the database system is first organized as a flat file (FIG. 9) and the flat file used to make a virtual data graph (VDG) in which the values in each column of the flat file are represented by one or more word thesauruses (FIG. 10A-H). For a given value belonging to a given column, the word thesaurus for the value indicates the rows in the flat file in which the given column has the given value. One of the techniques used to specify the rows which have the given value in the given column is a bitmap value. The bitmap has a bit for every row of the flat file. When the given value is present in the given row, the bitmap value for the given column so indicates. Where there are large numbers of different values in a given column, the word thesauruses may be organized into hierarchies of macroword thesauruses. All of the foregoing may of course be done automatically. For example, the data in the tables of a standard relational database system may be automatically reorganized as just described.

Once the data has been organized as just described in Koskas' database, it may be queried using standard SQL. This is shown in FIG. 36 and described at col. 31, line 61-col. 32 line 12. As described at col. 10, line 57-col. 11, line 20, in executing an SQL query, Koskas' system can use Boolean operations on the thesauruses' bitmap values to locate all of the rows of the flat file which contain values that satisfy a query. There is absolutely nothing in Koskas' disclosure to indicate that a *user* of the system has any access whatever to primitive operations on the bitmap values of the thesauruses. Koskas, though exceedingly complex, is thus just another example of

the prior art's use internally to a database system of bitmaps, bitmap values, and operations on the bit map values to speed up the operation of a database system.

Failure of Koskas to anticipate Applicants' independent claims 1, 22, 36, and 24

In her rejection of each of these claims, Examiner cites Figures 10 A-H, col. 9, lines 26-34, and col. 10, line 46- col. 11, line 20 of Koskas as disclosing the limitation that a user have access to primitive operations on the bitmaps. That limitation is expressed as follows at lines 9-11 in amended claim 1: "a bitmap operation having a user-specified operand which is a bitmap value and/or a set of objects". As would be expected from the foregoing general discussion of the disclosure of Koskas, the cited location in Koskas does not disclose the limitation that a user have access to primitive operations on the bitmaps.

As already pointed out, FIGs. 10 A-H show word thesauruses which include bitmap values. Col. 9, lines 26-34 read as follows:

> The database system according to the invention makes use of the flat file concept. However, it does not require the storage of the flat file as shown in FIG. 8, hence the concept of "virtual flat file" containing "virtual data graphs" (VDG). The term "virtual" refers to the fact that the flat file or data graphs need not be maintained explicitly in memory, although their data structure is used as a reference in the execution of the method.

Col. 10, line 46-col. 11, line 20 read as follows:

> Two alternative representations of the data graph identifier lists in the thesauruses are illustrated in FIGS. 10A-G for the seven attribute columns of FIGS. 1-3. The first one is the form of explicit integer lists.
>
> The second (equivalent) representation is in the form of bitmap vectors whose length is equal to (or greater than) the number of rows in the virtual flat file, i.e. the number of data graphs. The bit of position i in a bitmap vector (i-gt;=0) indicates whether the integer i belongs (1) or not (0) to the row-ID list represented by the bitmap vector. In our simplified example, the flat file has 12 rows so that the bitmap vectors may be of dimension 12.
>
> The above-described data structure, comprising a virtual flat file and sorted thesaurus files pointing to rows of the virtual flat file is referred to herein as a VDG structure.
>
> The VDG structure provides a powerful tool for efficiently processing queries in the database.
>
> The virtual flat file is a reference table which defines a unified algebraic

> framework for the entries of all the thesauruses. The query criteria are examined with reference to the relevant thesauruses to obtain a flat file row-ID list (or bitmap vector) which represents all data graphs matching the query criteria, if any. The results can then be delivered by accessing the link table rows pointed to in that row-ID list to read the links which appear in part or all of the columns in order to retrieve attributes values as desired for the result presentation.
>
> The processing with reference to the thesauruses mainly consists in logical operations performed on the row-ID lists to which they point. If they are represented as integer lists, such operations can be reduced to basic merge, intersect and/or complement operations, which respectively correspond to Boolean OR, AND, NOT operations in the bitmap representation.
>
> The VDG structure also provides an efficient tool for accessing the contents of the database, which does not require accesses to the data tables. This tool is well suited to queries having special result presentation features such as SORT, COUNT, DISTINCT, ORDER BY, GROUP BY, etc. clauses, and also for carrying out any type of calculation on the data values of the records which match the query.

The foregoing describes the thesauruses of FIGs. 10 A-G and how the Boolean operations made possible by the thesauruses' bit map values may be used to efficiently execute queries. It further describes how the VDG structure permits efficient execution of the standard SQL SORT COUNT, DISTINCT, ORDER BY, GROUP BY clauses. None of this involves direct access by a user of a database system which employs the VDG structure to primitive operations on the bitmap values in the thesauruses or anything like amended claim 1's form of that limitation, namely "a bitmap operation having a user-specified operand which is a bitmap value and/or a set of objects". Because there is no such disclosure here or anywhere else in Koskas, the reference does not anticipate claim 1; as Examiner will immediately see, for the same reasons, Koskas fails to anticipate the remaining independent claims 22, 36, and 44 or any of the claims dependent from those claims.

Independent patentability of the dependent claims

Claims 2-11 all include additional limitations which further limit the "bitmap operation having a user-specified operand" of claim 1, and since Koskas does not disclose such bitmap operations, it necessarily cannot disclose the additional limitations and claims 2-11 are independently patentable over the reference. There is further no disclosure in Koskas of the "bitmap values in user-specified fields" of claims 13 and 31, or of the limitation of claims 17 and 46 that "the row identifiers [which are the operand in the bitmap operation] are "row identifiers returned by a

user-defined query executed in the database management system" or of the further limitation in claim 18. There is also no disclosure in Koskas of bitmaps that specify anything other than row identifiers; consequently, claims 19, 20, and 38 are independently patentable over Koskas.

In her rejections of claims 2-11, Examiner additionally cites col. 11, lines 22-50. The cited location gives an example of how the VDG structure may be used to execute a query. The query does not involve any bitmap operations having user-specified operands, as required for all of dependent claims 2-11, and the cited location in fact describes how the thesauruses are used internally by Koskas' system to speed up the execution of the example query. The disclosure of col. 11, lines 22-50 thus amounts to yet another example of the prior-art use of bitmaps and bitmap values internally in a database system to speed up query execution.

Conclusion

Applicants have amended claim 36 to overcome the rejection under 35 U.S.C. 112, 2. par, have amended claim 1 to overcome the rejection of that claim under 35 U.S.C. 101, have traversed the rejections of claims 22 and 44 under 35 U.S.C. 101, and have traversed the rejection of claims 1-27, 29-36, and 38-47 under 35 U.S.C. 102(e) as anticipated by Koskas. Applicants have further demonstrated that the claims as amended are fully supported by the Specification as originally filed. Applicants have thus fulfilled the requirements of 37 C.F.R. 1.111(b) and respectfully request that Examiner enter the amendment, continue with her examination, and allow the claims as amended, as provided by 37 C.F.R. 1.111(a). No fees are believed to be required for this amendment; should any be, please charge them to deposit account number 501315.

Respectfully submitted,

/Gordon E. Nelson/

Attorney of record,
Gordon E. Nelson
57 Central St., P.O. Box 782
Rowley, MA, 01969,
Registration number 30,093
Voice: (978) 948-7632
Fax: (866) 723-0359

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